CALIFORNIA
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NEWS

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Contents Highlights

California Water Plan News is a publication of the Department of Water Resources' statewide planning program. One of the program's major activities is updating the California Water Plan (Bulletin 160) every five years. As part of this work, DWR staff collect and analyze data on land and water use, and forecast future conditions affecting statewide water supplies and demands. This newsletter describes data and forecasting techniques associated with statewide water supply planning. It also provides an overview of conditions or developments influencing planning at the state level. We welcome your questions and comments on material presented here.

California Water Plan News
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Urbanization of the West

Forecasting water use in California depends on several key variables—such as population for urban water use and irrigated acreage for agricultural water use. Department of Water Resources water use forecasts for the last edition of the *California Water Plan* update (Bulletin 160-93) and for the pending version (Bulletin 160-98) show, not surprisingly, an increase in urban water use and a slight decline in agricultural water use, as California grows from its present population of 32.7 million to about 48 million in 2020. A variety of demographic and economic trends will shape how future population is geographically distributed and how land use changes will occur.

Similar trends also affect other western states—California is not alone in facing an increasingly urbanized population. In a 1997 report prepared for the Western Water Policy Review Advisory Commission, Pamela Case and Gregory Alward of the U.S. Forest Service make some interesting observations about trends in the 17 western states (conventionally, the 17 western states are defined as those served by U.S. Bureau of Reclamation water projects). The following points from their report, *Patterns of Demographic, Economic, and Value Change in the Western United States*, help place California in perspective with other western states.

▶ As we approach a new century, the most heavily populated areas of the United States are now the western coastal states, the southwest, and Florida. Populations of the Great Lakes states, the midwest, and the east coast have declined relative to the rest of the U.S. At the turn of

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East Contra Costa County Water Supply Management Study

Information for this article was contributed by Larry Preston, Manager of East Contra Costa Irrigation District.

This article profiles a cooperative water supply study conducted by agricultural and urban water supply agencies and wastewater treatment agencies in eastern Contra Costa County. An interesting feature of this study was the concept of pooling surface water supplies held by the agencies under their individual water rights or contracts, to help facilitate local water management.

The East County Water Management Association, an organization of 11 local agencies in eastern Contra Costa County, conducted a water supply management study to identify and evaluate potential water management strategies for meeting the area's future water needs. The study was initiated in response to urban growth pressures from the San Francisco metropolitan area in formerly rural communities such as Antioch, Oakley, and Brentwood.

The study analyzed future demands, water supplies, existing infrastructure, and general issues related to cooperative water resources management, and evaluated alternatives for providing water supplies through 2040.

Because the East County has access to significant surface water supplies through Central Valley Project contracts and local diversions, study results indicated that in-county surface water supplies could meet the study area's future water demands in a normal hydrologic year. However, in a drought year, deficits would occur after 2010. Current groundwater use in the study area amounts to 14,500 acre-feet per year. Some areas depend entirely on groundwater, while other areas use it to supplement surface water supplies. Existing groundwater quality problems in the East County may limit future groundwater development.

Three water supply scenarios were evaluated. The scenario selected would entail continued groundwater pumping with maximized local pooling of surface water supplies. The pooling concept would

ECWMA's member agencies are:

Byron-Bethany Irrigation District
City of Antioch
City of Brentwood
City of Pittsburg
Contra Costa County Sanitation District No.19
Contra Costa County Water Agency
Contra Costa Water District
Delta Diablo Sanitation District
Diablo Water District
East Contra Costa Irrigation District
Ironhouse Sanitary District

require negotiation of new agreements for the long-term transfer of surplus water supplies from two agricultural districts (ECCID and BBID) to the agencies serving ECWMA urban areas. Changes to the place of use/purpose of use in existing water rights would also be needed. This scenario would require additional supply only during drought conditions. Spot water transfers and short-term demand management would provide the drought year supply.

Some specific recommendations made in the study included:

- A comprehensive groundwater study of the East County area should be commissioned by ECWMA. The study should focus on groundwater quantity and quality and on interactions between surface water and groundwater supplies.
- An in-county conjunctive-use program to manage dry-year shortages should be evaluated.
- An aquifer storage and recovery program should be investigated in the Randall-Bold water treatment plant area in the event that ECWMA member agencies are required to limit their Delta diversions at some times of the year.
- ECWMA members should construct dual water distribution systems to facilitate future use of reclaimed water in all water service areas within ECWMA.
- Interties between water treatment plant service areas increase reliability and flexibility during emergencies. The cities of Pittsburg and Antioch, CCWD, and DWD should discuss potential intertie benefits associated with CCWD's seismic and reliability improvement project. ❖

Geothermal Heat Exchange Well Standards

Carl Hauge is a supervising engineering geologist with the Statewide Planning Branch.

Recent State legislation (Water Code §13700 et.seq.) requires the Department of Water Resources to develop and adopt standards for the construction and destruction of geothermal heat exchange wells. (Geothermal heat exchange wells are also called ground source heat pumps.) The same law requires the State Water Resources Control Board to adopt a model ordinance pertaining to ground source heat pump wells.

Geothermal heat exchange wells use the temperature of the earth as a heat exchange medium for heating and refrigeration systems in residences and office buildings. The advantage is a large savings in energy used to heat and cool the space.

Each well consists of a small diameter boring (4-8 inches) into which 1 or 1-1/4 inch diameter polyethylene tubing is inserted. Before insertion into the borehole, the tubing is heated and fused into a closed loop within which the fluid is contained and is circulated from the borehole through the heat exchanger.

Once the tubing is emplaced, high solids bentonite grout is pumped into the borehole by means of a tremie pipe. The bentonite is the heat exchange medium that transfers heat either *to* the geologic formation for cooling the structure, or *from* the geologic formation for heating purposes.

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Water Reclamation Development in San Diego County

Information for this article was contributed by San Diego County Water Authority.

For our next update of the *California Water Plan*, we are estimating that wastewater recycling will contribute almost 700,000 acre-feet of new water supply statewide by 2020. (The Department of Water Resources defines new water supply in this context as water reclaimed from treatment plant discharges that would otherwise flow directly to the ocean or to a salt sink.) Recycling projects will be an important source of new supply for coastal urbanized areas. This article provides a status update on two cooperative programs in San Diego County that could yield over 75,000 af annually.

The San Diego area water reclamation program is a cooperative effort among the cities of San Diego, Escondido, and Poway; the Otay Water District; the Padre Dam Municipal Water District; the Sweetwater Authority; the Tia Juana Valley County Water District; and the San Diego County Water Authority. When completed, the program will add over 61,000 af to the San Diego region's local water supply. The total capital cost of the program is approximately $662 million (1997 dollars). Program funding sources include local ratepayers, low-interest state loans, Metropolitan Water District of Southern California, and federal cost-sharing authorized under Title 16 of Public Law 102-575. This federal statute authorizes the U.S. Bureau of Reclamation to cost-share up to 25 percent (planning, design, and construction) of specified wastewater recycling projects, including the San Diego area program.

Construction has been completed or will begin shortly on several facilities. Padre Dam Municipal Water District has completed expansion of its reclamation facilities. Padre Dam Municipal Water District has operated a reclamation program since 1961. Its Santee Lakes water reclamation facility furnishes 600 af of water per year for use at Santee Lakes, seven artificial lakes located at the Santee Lakes Regional Park, and at a nearby campground. Padre Dam MWD is expanding the Santee Lakes facility to provide a more reliable supply of water for Santee Lakes and to irrigate residential greenbelts, schools, parks, street medians, and freeway embankments. The initial phase of the project expanded facility capacity from 1 million gallons per day to 2 mgd and added nutrient removal capability. A distribution system with storage and pumping facilities and 25 miles of pipelines was constructed to deliver 850 af of reclaimed water annually to over 80 user sites.

The City of San Diego completed construction of its flagship reclamation facility, the 30 mgd North City Water Reclamation Plant, in April 1997. The North City plant could ultimately provide about 8,700 af of reclaimed water annually to meet commercial, industrial, and landscape irrigation demands in northern and central San Diego and the southern portions of the neighboring City of Poway. Initial users will include Torrey Pines Golf Course, Miramar Naval Air Station, South Poway Business Park, and Caltrans, as

well as numerous schools, parks, nurseries, and residential homeowner associations. The distribution system is complete and should begin delivering reclaimed water by December 1997.

The City of San Diego also proposes to construct an 18 mgd water repurification facility to treat reclaimed water from the North City Water Reclamation Plant. The repurified water would be transported over 20 miles to the San Vicente Reservoir for blending with imported raw water supplies. The blended water would eventually be conveyed via the existing El Monte Pipeline to the Alvarado Water Filtration Plant. There, the water would undergo additional filtration and disinfection before being introduced into the City's potable water delivery system. The City of San Diego has begun design and environmental review of the project. The Water Repurification Program could begin operation in late 2001.

Agencies in north San Diego County have also joined to develop a program that would add over 15,000 af of recycled water annually to the San Diego region's local water supply. The agencies include the Carlsbad Municipal Water District, the

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Photo courtesy of the City of San Diego

The City of San Diego's North City Water Reclamation Plant will begin delivering water in December 1997.

Water Reclamation Development in San Diego County

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Leucadia County Water District, the Olivenhain Municipal Water District, and the San Elijo Joint Powers Authority. The total capital cost of the program is approximately $90 million (1997 dollars). Program funding sources include local ratepayers, low-interest state loans, Metropolitan Water District, and federal cost-sharing. The North San Diego County area water recycling project was authorized for federal funding in 1996 and hopes to receive an appropriation in federal fiscal year 1999.

Planning and design have been completed on several projects included in the North San Diego County area water recycling project. The San Elijo JPA (located in an area completely dependent on imported water) will begin construction of its recycling facilities in early 1998 and anticipates completion in mid-1999. The 1,550 af project will provide a reliable, drought-proof water supply to the region. Recycled water will be delivered in 90 user sites through a network of 17 miles of distribution pipeline. ❖

FERC Relicensing Update

Statewide Planning Branch staff

The Federal Energy Regulatory Commission administers a program of licensing nonfederal hydroelectric power plants. Licenses for many California hydropower plants will be coming up for renewal in the relatively near future, and FERC has begun to schedule regulatory activities for plants with licenses expiring in 2000 to 2010 (Table 1).

FERC licenses contain conditions on the owners' operation of the plants. Typical conditions include instream flow requirements and other fishery protection measures. The relicensing process allows resource agencies and individuals to request that FERC consider increasing the licensee's instream flow requirements. Proposals for fishery restoration in the Central Valley, such as those in the draft anadromous fishery restoration plan for the Central Valley Project Improvement Act, have taken into consideration the possibility of changing flow requirements.

At this time, the impacts of electric power industry deregulation, and how that deregulation will affect relicensing, are uncertain. It appears that current owners of some generating facilities (especially smaller plants) may sell their generation assets as part of deregulation. ❖

Table 1. California Hydropower Projects - License Years 2000 - 2010 (projects over 1,000 kW)

License Expiration Date	Project Name	Stream	Licensee	Capacity kW
6-14-2000	Lower Tule	Middle Fork Tule River	S. Calif. Edison	2,000
9-30-2000	Hat Creek No. 1 & 2	Hat Creek & Pit River	Pacific Gas & Electric	20,000
2-23-2002	El Dorado	South Fork American River	PG&E	20,000
4-26-2003	San Gorgonio No. 1 & 2	San Gorgonio Creek	SCE	2,250
8-31-2003	Vermillion Valley	Mono Creek	SCE	N/A
9-30-2003	Poe	North Fork Feather River	PG&E	142,830
10-31-2003	Pit	Pit River	PG&E	317,000
4-30-2004	Santa Felicia Reservoir	Piru Creek Santa Clara River	United Water Conservation District	1,434
10-31-2004	U N Fork Feather River	North Fork Feather River	PG&E	342,000
12-31-2004	Donnells & Beardsley	Middle Fork Stanislaus River	Oakdale & South San Joaquin Irrigation Districts	63,990
12-31-2004	Tulloch	Stanislaus River	Oakdale & South San Joaquin Irrigation Districts	17,100
12-31-2004	Stanislaus - Spring Gap	South Fork Stanislaus River	PG&E	175,800
2-28-2005	Borel	Kern River	SCE	9,200
3-31-2005	Portal	Rancheria Creek Big Creek	SCE	10,000
4-30-2005	Kern Canyon	Kern River	PG&E	11,500
2-28-2006	Klamath	Klamath River	Pacificorp	231,000
1-31-2007	Feather River	Off Stream Feather River	DWR	2,165,750
3-27-2007	Kilarc & Cow Creek	Old Cow Creek & Cow Creek	PG&E	8,880
7-31-2007	Upper American River	South Fork American River	Sacramento Municipal Utility District	722,259
7-31-2007	Chili Bar	South Fork American River	PG&E	7,020
11-30-2007	Mammoth Pool	San Joaquin River	SCE	181,000
2-28-2009	Big Creek No. 2A & 8	South Fork San Joaquin River	SCE	480,070
2-28-2009	Big Creek 3	San Joaquin River	SCE	177,450
2-28-2009	Big Creek No. 1 & 2	Big Creek & San Joaquin River	SCE	225,900
3-31-2009	South Fork	Kelly Ridge Canal	Oroville-Wyandotte Irrigation District	104,100
4-30-2009	Santa Ana No. 3	Santa Ana River	SCE	1,500

Geothermal Heat Exchange Well Standards

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Each ton of air conditioning requires 100 to 150 feet of tubing to provide adequate heat exchange with the geologic formation. Once the required number of boreholes is completed, tubing from the several wells on the property is tied together at a manifold that is buried underground, allowing normal landscaping around the structure. If the lot is large enough, the tubing can be installed in horizontal loops on the property.

The draft standards were prepared by DWR in consultation with a committee composed of representatives from the ground source heat pump industry; the drilling industry; electric utilities; and local, State, and federal regulatory agencies. The draft standards, which have been widely distributed, were reviewed recently at a public workshop. Notices of the workshop were mailed nationwide, and speakers at the workshop represented the industry. Comments obtained at the workshop will be evaluated, and the draft standards will be revised as appropriate.

Once the well standards are adopted, SWRCB will hold a public hearing on the model ordinance that counties will be required to adopt, unless the counties choose to develop and adopt their own ordinances.

The standards for geothermal heat exchange wells will join the standards for water wells, monitoring wells, and cathodic protection wells that have already been adopted and published by DWR and included in an earlier ordinance adopted by SWRCB. ❖

Solano County Land Use Survey Report

Barbara Cross is a supervising land and water use analyst and Tom Hawkins is a senior land and water use analyst, both with the Statewide Planning Branch.

Previous issues of this newsletter have covered the Department of Water Resources' land use survey program. A new report on the 1994 land use survey of Solano County is being released in late 1997.

The survey was based on aerial photographs taken in June 1994. The entire county was surveyed, encompassing all or parts of 30 USGS 7-1/2 minute quadrangle maps. Although the survey was a point-in-time estimate, information on multiple cropping patterns in a given field were recorded, if available. For example, irrigated grain might be followed by field corn. Intercropping might consist of grain intercropped with a permanent crop such as peach trees.

Results of the 1994 survey are summarized by crop groups and land use types. When those results are compared with DWR's 1972 and 1980 surveys,

trends may be observed, such as a decline in tree and vine crops from 20,000 acres in 1972 to 15,300 acres in 1994. Conversely, urban land use has increased from 21,200 acres to 55,500 acres over the same period, reflecting the growth of urbanized areas such as Vacaville, Fairfield, and Vallejo. Acreage of some crops fluctuates from year to year, depending on factors such as market demand and water availability. For example, acreage planted in corn, alfalfa, and truck crops fluctuated over the span of the three surveys. Table 2 summarizes the findings of the 1972, 1980, and 1994 surveys of Solano County.

The delivery of State Water Project water supplies beginning in the early 1970s created a significant increase in irrigated acres in Solano County. In particular, the availability of water enabled many more acres of irrigated wheat to be grown. Previously, most grain acreage had been dry-farmed.

The Montezuma Hills area in southeast Solano County does not have a developed water supply, and fields there are either cropped with dry-farmed grain or remain uncropped for one or more seasons. During a land use survey, nonirrigated fields left fallow for several years will be designated as native vegetation. The decrease in native vegetation between the 1972 and 1980 surveys was due to an increase in total irrigated acreage in the County enabled by SWP water supplies. The increase in native vegetation between the 1980 and 1994 surveys was due to nonirrigated fields in the Montezuma Hills reverting to native vegetation in the years preceding the 1994 survey. Cropping patterns in the Montezuma Hills have a significant influence on the amount of land mapped as native vegetation in Solano County land use surveys.

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Table 2. Summary of Solano County Land Use Surveys (Acres x 1,000)

Land Use	1972 Survey	1980 Survey	1994 survey	Change 1972-1994
Irrigated Crop Groups				
Grains & Field Crops	106.9	143.0	123.2	16.3
Truck Crops	22.0	19.5	24.7	2.7
Trees & Vines	20.0	17.4	15.3	-4.7
Total Irrigated Crop Acres	148.9	179.9	163.1	14.2
Irrigated, Fallow and Idle	3.3	3.1	8.1	4.8
Nonirrigated Crops & Fallow	61.6	53.6	35.2	-26.4
Farmsteads and Feedlots	0.2	1.8	2.6	2.4
Urban	21.2	42.9	55.5	34.3
Native Vegetation & Water Surface	348.9	309.7	321.5	-27.4

Solano County Land Use Survey Report

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Along with the 1994 survey of Solano County, DWR conducted a pilot project to evaluate the feasibility of using digital satellite imagery instead of low-altitude 35mm slide photography for interpretation of field boundaries. The 1994 survey of Solano County required more than 1,500 color slides. Generally, one 7-1/2 minute quadrangle map requires about 60 to 70 slides. Satellite and other high-elevation imagery covers much larger areas. Some of the questions raised by the pilot project included:

- Would the resolution of satellite imagery be serviceable?
- Would gray scale or multispectral imagery be more appropriate for drawing land use boundaries?
- Would acreage summaries from using satellite imagery be statistically similar to those from using slide photography?
- Would there be cost savings?

DWR chose three quadrangles for the pilot project and purchased two 1994 multispectral (color) scenes and one panchromatic (gray-scale) scene for the area. Spatial data sets were developed for comparison with data developed through conventional procedures. The difference was less than 5 percent for most crops using the summer satellite scenes. Harvested grains were difficult to determine from the summer satellite scenes. The differences for grains between the two methods were reduced to about two percent by using spring imagery to identify grains.

The pilot project revealed drawbacks to using satellite imagery. The resolution was much lower than that of slides, a significant change for the staff doing the interpretation. The low-density urban areas (the interface between urban and agricultural areas) were difficult to delineate. Working maps used by staff in the field lacked identifiable landmarks, making navigation for ground truthing more difficult. The cost of the satellite imagery was also higher than that of slides.

However, the pilot project led to a successful investigation of using high-elevation aerial photography. Such photography is available in 9-inch x 9-inch color prints. The prints are scanned into a digital file and, using ground control points, are warped into a projection. Four of these files may be assembled to form one 7-1/2 minute quadrangle, compared with about 60 to 70 slides. Both cost and resolution compare favorably with low-elevation slides. More importantly, the 9-inch x 9-inch photos greatly simplify handling of the imagery and creation of field sheets.

Copies of the Solano County land use survey report may be requested from DWR's Bulletins and Reports at (916) 653-1097. ❖

Urbanization of the West

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the 20th century, the U.S. population was concentrated in the eastern states.

▶ Economic activity in the western states (measured by contribution to the U.S. gross domestic product) is concentrated, along with population, in metropolitan areas such as Los Angeles, San Francisco, Sacramento, Phoenix, Tucson, Las Vegas, Albuquerque, El Paso, Dallas, Houston, Denver, Salt Lake City, Eugene, Portland, Seattle, Boise, Spokane, and Missoula. Some of these "urban archipelagos" are cities that as recently as the 1970s would have not been considered as significant metropolitan areas.

▶ From 1995 to 2000, nine of the nation's ten fastest growing states are expected to be in the west. Nevada, with a 22 percent projected growth rate, tops the list. From 1995 to 2025, California is expected to be the fastest growing state in the nation. In 1995, California contained 12 percent of the nation's population. By 2025, California is projected to have 15 percent of the U.S. population, the approximate equivalent of adding the current population of New York State to California.

▶ In general, agricultural activities that generated the highest earnings shifted westward from 1977 to 1993. The activities located nearest metropolitan areas tended to have the highest earnings (in California, agricultural activities in the Central Valley, Central Coast area, and throughout Southern California).

▶ Among the western states, the largest future water demands are expected to occur in California, Texas, Nevada, and Utah. California and Texas will have the largest demands in terms of quantities, because both states are projected to have significant population increases and both contain substantial irrigated agricultural acreage. Although Nevada and Utah will have large percentage increases in their water demands, the quantities of water involved will be less.

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Bulletin 160-98

The public review draft of Bulletin 160-98, the California Water Plan update, will be released in late January. The Department of Water Resources will also hold a series of public meetings in February to take comments on the draft. We will be sending copies of the public review draft to persons on the mailing list for this newsletter. If you are not on the newsletter mailing list and wish to receive a copy of the draft (the document will be about 500 pages long), please call Ginny Sajac at (916) 653-7101.

Statewide Statistics

California is the nation's most populous state and its top-ranking agricultural state in terms of dollar value of farm products. Table 3 shows the population of California's ten most populous counties, and Table 4 shows the ten top agricultural producing counties (based on wholesale value of farm products).

Table 3 — California's 1996 Population — Top 10 Counties (million people)

Los Angeles	9.40
San Diego	2.69
Orange	2.65
Santa Clara	1.64
San Bernardino	1.59
Riverside	1.39
Alameda	1.34
Sacramento	1.13
Contra Costa	0.88
Fresno	0.78

source: California Department of Finance, July 1996 estimate

Table 4 — Top 10 Agricultural Counties in California in 1996 (billion dollars)

Fresno	$3.31
Tulare	2.80
Kern	2.07
Monterey	1.94
Merced	1.43
San Joaquin	1.35
Stanislaus	1.23
Riverside	1.14
San Diego	1.11
Imperial	0.96

source: California Department of Food and Agriculture

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